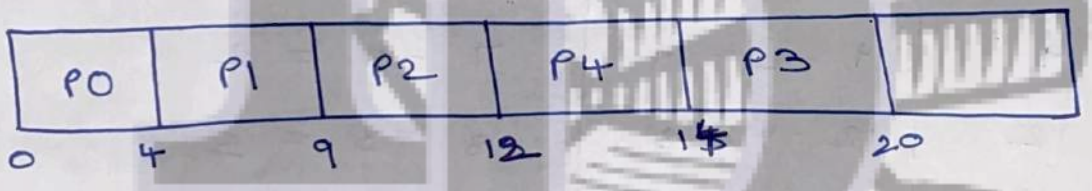
Operating System

Digital Assignment

1) Highest Response Ratio Next Scheduling (Non Pre-emptive)

Process ID	Arrival Time	Burst Time
0	0	4
1	2	5
2	4	3
3	6	6
4	8	2

Gantt chart:



- At t = 0, only process P0 is available in ready queue.
- At t = 4, only P1 is available.
- At t = 9, P2, P3 & P4 are available.

response ratio for,

Response ratio $= \frac{W.T. + B.T.}{B.T.}$

$$P2 = \frac{(9-4)+5}{5} = \frac{9}{5} = 2.6$$

$$P3 = \frac{(9-6)+6}{6} = \frac{9}{6} = 1.5$$

$$P4 = \frac{(9-8)+2}{2} = \frac{3}{2} = 1.5$$

P2 has highest response ratio, so process P2 executes

- At $t = 13$, P3 & P4 are available in ready queue.

Response ratio for,

$$P3 = \frac{(13-6)+6}{6} = \frac{13}{6} = 2$$

$$P4 = \frac{(13-8)+2}{2} = \frac{7}{2} = 3$$

P4 has highest response ratio, so P4 executes.

Turn Around Time (T.A.T.) = Exit time − Arrival Time

Waiting Time (W.T.) = T.A.T. − Burst time

Process ID	Exit time	T.A.T.	W.T.
P0	4	4 − 0 = 4	4 − 4 = 0
P1	9	9 − 2 = 7	7 − 5 = 2
P2	12	12 − 4 = 8	8 − 3 = 5
P3	20	20 − 6 = 14	14 − 6 = 8
P4	14	14 − 8 = 6	6 − 2 = 4

Avg. T.A.T = $\frac{4+7+8+14+6}{5} = \frac{39}{5} = 7.8$ units

Avg. W.T. = $\frac{0+2+5+8+4}{5} = \frac{17}{5} = 3.4$ units

CPU utilization = $\frac{\text{busy time}}{\text{busy time + idle time}} \times 100$

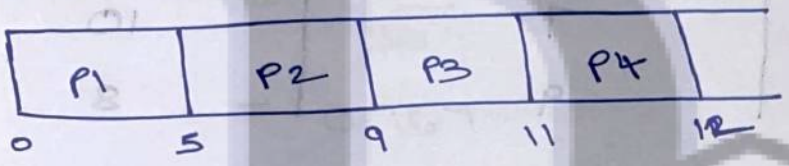
$= \frac{20}{20+0} \times 100 = 100\%$

Throughput = $\frac{\text{processes}}{\text{time unit}} = \frac{5}{20} = 0.25$

2) given. Priority Scheduling (Pre-emptive)

Process ID.	Priority	Arrival Time	Burst Time
1	10	0	5
2	20	1	4
3	30	2	2
4	40	4	1

Gantt chart.



Proc. ID	Priority	A.T.	B.T.	T.A.T. CT. − A.T.	W.T. T.A.T − B.T.
1	10	0	5	5 − 0 = 5	5 − 5 = 0
2	20	1	4	9 − 1 = 8	8 − 4 = 4
3	30	2	2	11 − 2 = 9	9 − 2 = 7
4	40	4	1	12 − 4 = 8	8 − 1 = 7

Avg. T.A.T = $\frac{5+8+9+8}{4} = \frac{30}{4} = 7.5$

Avg. W.T. = $\frac{0+4+7+7}{4} = \frac{18}{4} = 4.5$

CPU utilization = $\frac{\text{busy time}}{\text{busy time + idle time}} \times 100$

$= \frac{12}{12+0} \times 100 = 100\%$

Throughput = $\frac{\text{no. of processes completed}}{\text{time unit}}$

$= \frac{4}{12}$

$= 0.33$

3) given.

6 processes named P1, P2, P3, P4, P5 & P6.

Time quantum of system is 4 units.

Process ID	Arrival Time	Burst Time
1	0	5
2	1	6
3	2	3
4	3	1
5	4	5
6	6	4

Ready Queue :

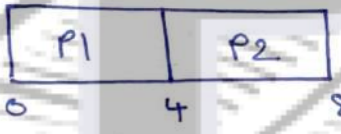
P1
5

Gantt chart :

Ready Queue :

P2	P3	P4	P5	P1
6	3	1	5	1

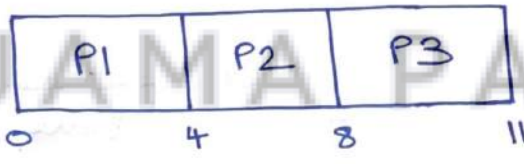
Gantt chart :



Ready Queue :

P3	P4	P5	P1	P6	P2
3	1	5	1	4	2

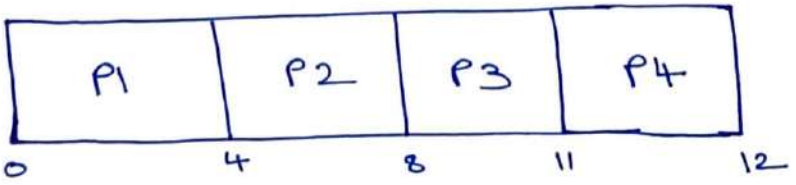
Gantt chart :



Ready Queue :

P4	P5	P1	P6	P2
1	5	1	4	2

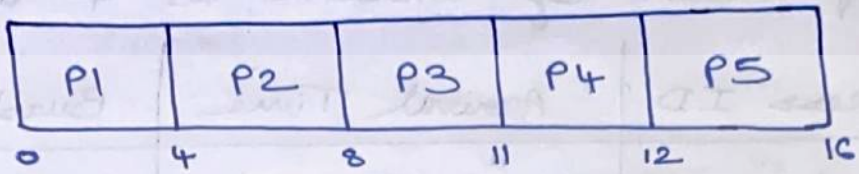
Gantt chart :



Ready Queue :

P5	P1	P6	P2
5	1	4	2

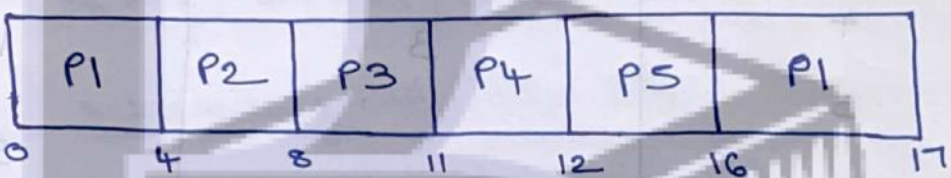
Gantt chart :



Ready Queue :

P1	P6	P2	P5
1	4	2	1

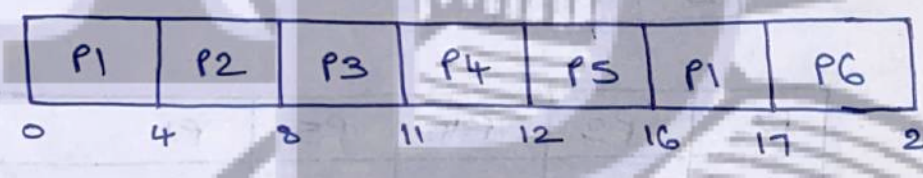
Gantt chart :



Ready Queue :

P6	P2	P5
4	2	1

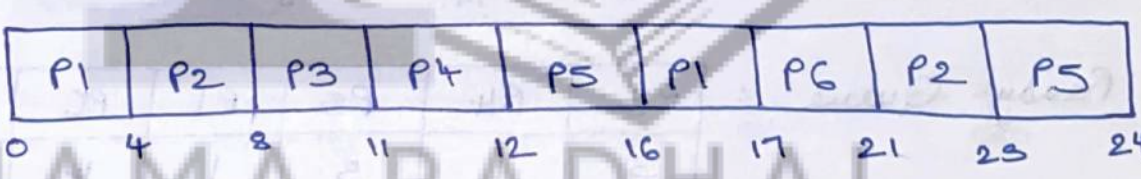
Gantt chart :



Ready Queue :

P2	P5
2	1

Gantt chart :



Turn Around Time (T.A.T.) = Completion time − Arrival time

Waiting Time (W.T.) = T.A.T. − Burst Time

Process ID	Arrival Time	Burst Time	Completion Time	T.A.T.	W.T.
1	0	5	17	17	12
2	1	6	23	22	16
3	2	3	11	9	6
4	3	1	12	9	8
5	4	5	24	20	15
6	6	4	21	15	11

$$\text{Avg. W.T.} = \frac{12+16+6+8+15+11}{6} = \frac{76}{6} = 12 \text{ units}$$

$$\text{Avg. T.A.T.} = \frac{17+22+9+9+20+15}{6} = \frac{92}{6} = 15.33 \text{ units}$$

4) given. First Come First Serve CPU Scheduling

Process ID	Process Name	Arrival Time (A.T.)	Burst Time (B.T.)
P1	A	0	5
P2	B	1	3
P3	C	2	8

Gantt chart.

Proc. ID	Proc. Name	A.T.	B.T.	T.A.T. C.T. − A.T.	W.T. T.A.T. − B.T.
1	A	0	5	5 − 0 = 5	5 − 5 = 0
2	B	1	3	8 − 1 = 7	7 − 3 = 4
3	C	2	8	16 − 2 = 14	14 − 8 = 6

Avg. T.A.T. $= \frac{5 + 7 + 14}{3} = \frac{26}{3} = 8.67$

Avg. W.T. $= \frac{0 + 4 + 6}{3} = \frac{10}{3} = 3.33$

CPU utilization $= \frac{\text{busy time}}{\text{busy time + idle time}} \times 100$

$= \frac{16}{16 + 0} \times 100 = 100\%$.

Throughput $= \frac{\text{no. of processes completed}}{\text{time unit}}$

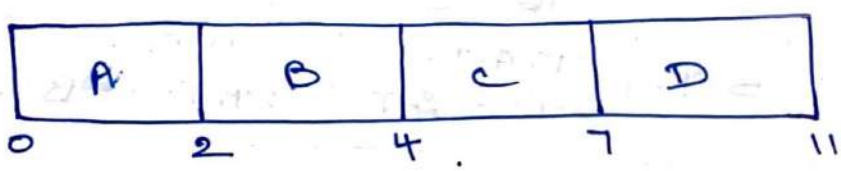
$= \frac{3}{16}$

$= 0.1875$

(5) given. First come First Serve CPU scheduling

Process ID.	Process Name	Arrival Time	Burst Time
P1	A	0	2
P2	B	1	2
P3	C	5	3
P4	D	6	4

Gantt chart.



Proc. ID	Proc. Name	A.T.	B.T.	T.A.T C.T. − A.T	W.T. T.A.T. − B.T.
P1	A	0	2	2 − 0 = 2	2 − 2 = 0
P2	B	1	2	4 − 1 = 3	3 − 2 = 1
P3	C	5	3	7 − 5 = 2	2 − 3 = −1
P4	D	6	4	11 − 6 = 5	5 − 4 = 1

$$\text{Avg. T.A.T.} = \frac{2+3+2+5}{4} = \frac{12}{4} = 3$$

$$\text{Avg. W.T.} = \frac{0+1-1+1}{4} = \frac{1}{4} = 0.25$$

$$\text{CPU utilization} = \frac{\text{busy time}}{\text{busy time + idle time}} \times 100$$

$$= \frac{11}{11+0} \times 100 = 100\%$$

$$\text{Throughput} = \frac{\text{no. of processes completed}}{\text{time unit}}$$

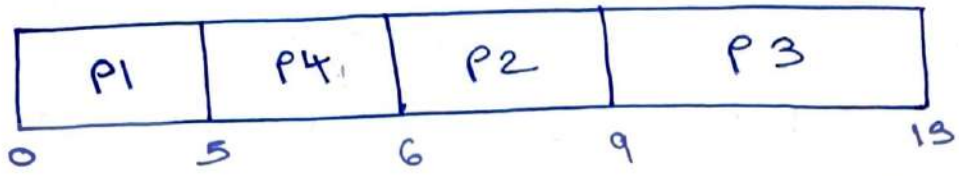
$$= \frac{4}{11}$$

$$= 0.3636$$

6) Shortest Job First CPU Scheduling
(Non pre-emptive approach)

Process ID	Process Name	Arrival Time	Burst Time
P1	A	0	5
P2	B	1	3
P3	C	2	4
P4	D	4	1

Gantt chart.



Proc. ID	Proc. Name	A.T.	B.T.	T.A.T CT. − A.T.	W.T. TAT − B.T.
P1	A	0	5	5 − 0 = 5	5 − 5 = 0
P2	B	1	3	6 − 1 = 5	5 − 3 = 2
P3	C	2	4	9 − 2 = 7	7 − 4 = 3
P4	D	4	1	13 − 4 = 9	9 − 1 = 8

$$\text{Avg. T.A.T.} = \frac{5 + 5 + 7 + 9}{4} = \frac{26}{4} = 6.5$$

$$\text{Avg W.T.} = \frac{0 + 2 + 3 + 8}{4} = \frac{13}{4} = 3.25$$

$$\text{CPU utilization} = \frac{\text{busy time}}{\text{busy time + idle time}} \times 100$$

$$= \frac{13}{13 + 0} \times 100 = 100\%$$

$$\text{Throughput} = \frac{\text{no. of processes completed}}{\text{time unit}}$$

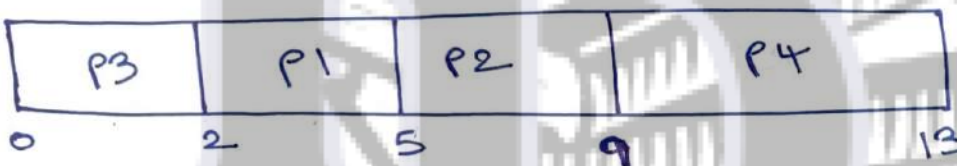
$$= \frac{4}{13}$$

$$= 0.307$$

7) Shortest Job First CPU scheduling
(Pre-emptive approach)

Process ID	Process Name	Arrival Time	Burst Time
P1	A	1	3
P2	B	2	4
P3	C	1	2
P4	D	4	4

Gantt chart:



Proc. ID	Proc. Name	A.T.	B.T.	TAT CT − AT	WT TAT − BT
P1	A	1	3	2 − 1 = 1	1 − 3 = −2
P2	B	2	4	5 − 2 = 3	3 − 4 = −1
P3	C	1	2	9 − 1 = 8	8 − 2 = 6
P4	D	4	4	13 − 4 = 9	9 − 4 = 5

$$\text{Avg. TAT} = \frac{1+3+8+9}{4} = \frac{21}{4} = 5.25$$

$$\text{Avg. WT} = \frac{-2-1+6+5}{4} = \frac{8}{4} = 2$$

$$\text{CPU utilization} = \frac{\text{busy time}}{\text{busy time + idle time}} \times 100$$

$$= \frac{13}{13+0} \times 100 = 100\%.$$

$$\text{Throughput} = \frac{\text{no. of processes completed}}{\text{time unit}}$$

$$= \frac{4}{13}$$

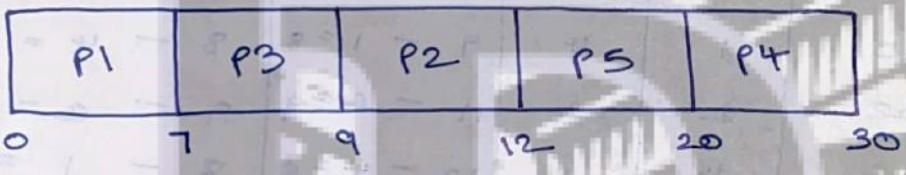
$$= 0.307$$

8) Shortest Job First CPU scheduling.

(Non pre-emptive approach)

Proc. ID	Proc Name	Arrival Time	Burst Time
P1	A	1	7
P2	B	3	3
P3	C	6	2
P4	D	7	10
P5	E	9	8

Gantt chart.



Proc. ID	Proc Name	A.T.	B.T.	TAT CT − AT	WT TAT − BT
P1	A	1	7	7 − 1 = 6	6 − 7 = −1
P2	B	3	3	9 − 3 = 6	6 − 3 = 3
P3	C	6	2	12 − 6 = 6	6 − 2 = 4
P4	D	7	10	20 − 7 = 13	13 − 10 = 3
P5	E	9	8	30 − 9 = 21	21 − 8 = 13

$$\text{Avg. TAT} = \frac{6+6+6+13+21}{5} = \frac{52}{5} = 10.4$$

$$\text{Avg. WT} = \frac{-1+3+4+3+13}{5} = \frac{22}{5} = 4.4$$

$$\text{CPU utilization} = \frac{\text{busy time}}{\text{busy time + idle time}} \times 100$$

$$= \frac{30}{30 + 0} \times 100 = 100\%$$

$$\text{Throughput} = \frac{\text{no. of processes completed}}{\text{time unit}}$$

$$= \frac{5}{30}$$

$$= 0.167$$

9) given.

Disk queue with requests for I/O to blocks on cylinders 98, 183, 41, 122, 14, 124, 65, 67.

FCFS, SSTF, LOOK & SCAN scheduling algorithm is used

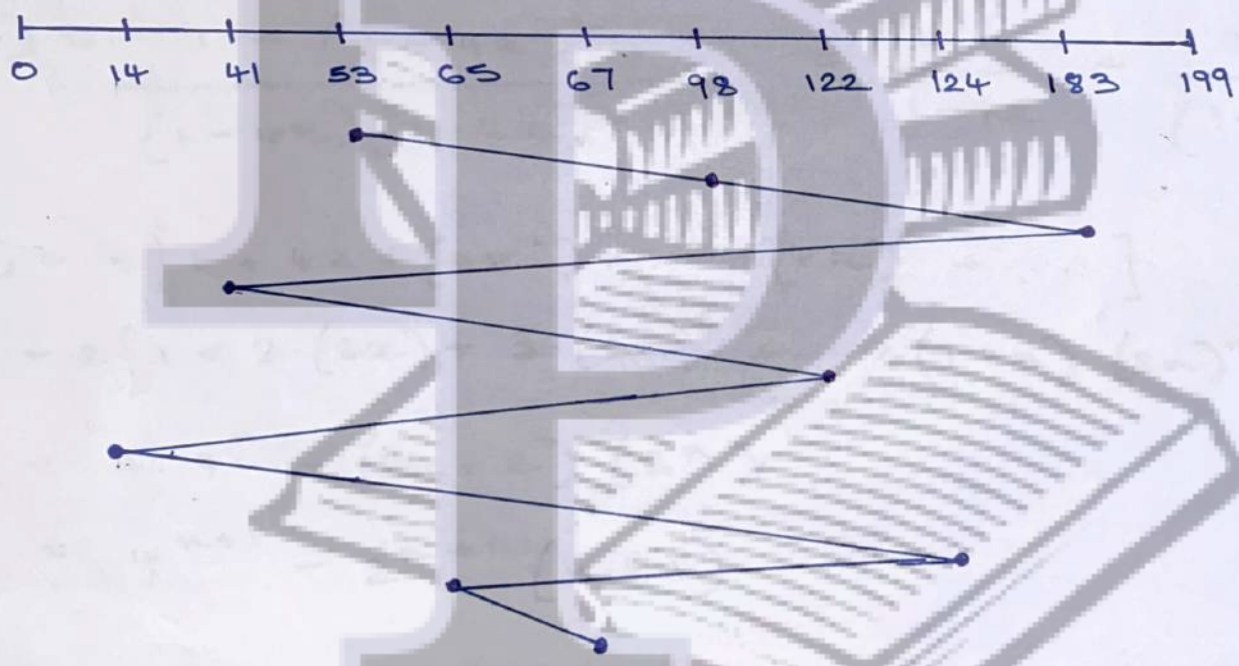
Head is initially at cylinder no. 53.

Cylinders are numbered from 0 to 199.

What is the total head movement (in no. of cylinders) incurred while servicing these requests?

Ans.

FCFS disk scheduling :—



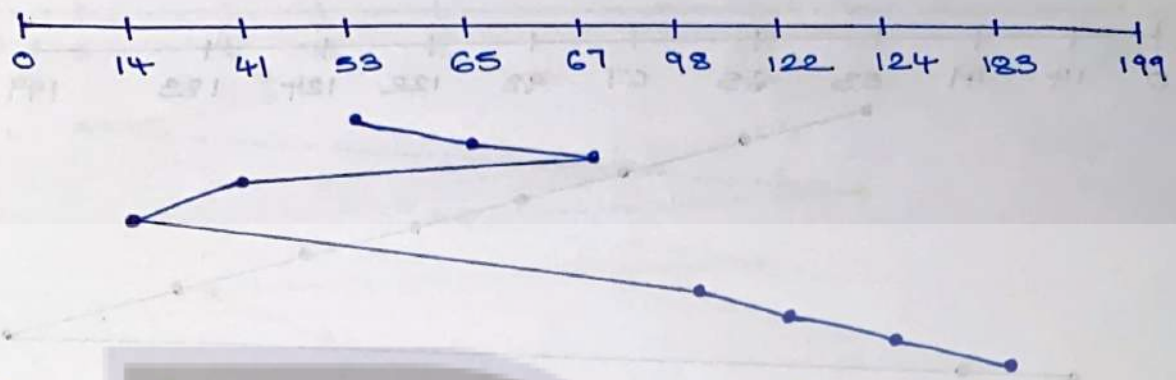
Total head movements incurred while servicing these requests.

$= (98-53) + (183-98) + (183-41) + (122-41) + (122-14) + (124-14) + (124-65) + (67-65)$

$= 45 + 85 + 142 + 81 + 108 + 110 + 59 + 2$

$= 632$

SSTF disk scheduling :—



Total head movements incurred while servicing these requests.

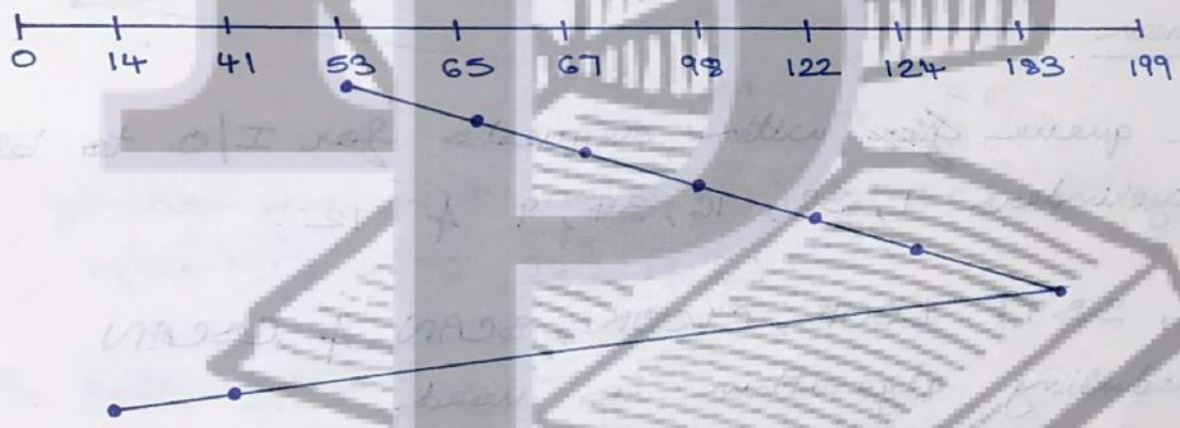
$= (65-53) + (67-65) + (67-41) + (41-14) + (98-14) +$

$(122-98) + (124-122) + (183-124)$

$= 12 + 2 + 26 + 27 + 84 + 24 + 2 + 59$

$= 236$

LOOK disk scheduling :—



Total head movements incurred while servicing these requests.

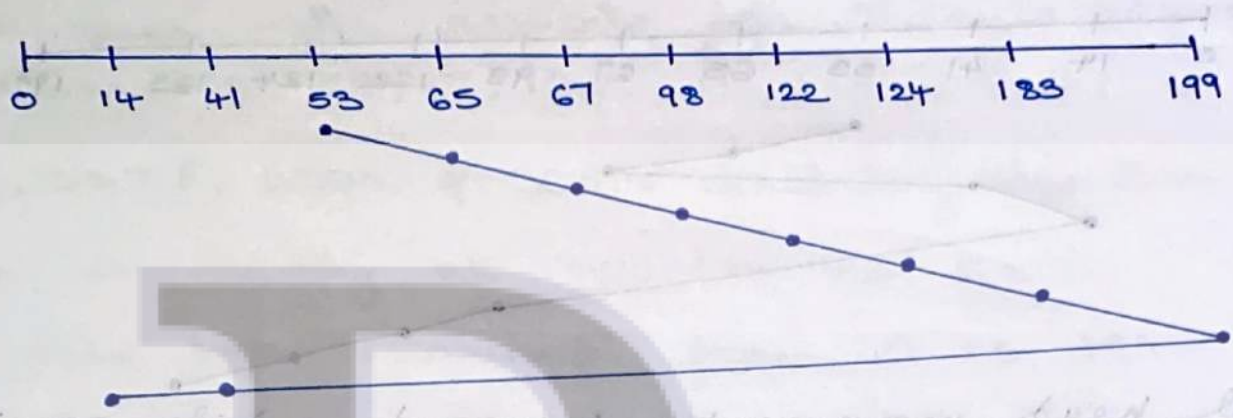
$= (65-53) + (67-65) + (98-67) + (122-98) + (124-122)$

$+ (183-124) + (183-41) + (41-14)$

$= 12 + 2 + 31 + 24 + 2 + 59 + 142 + 27$

$= 299$

SCAN disk scheduling :-



Total head movements incurred while servicing these requests.

$= (65-53)+(67-65)+(98-67)+(122-98)+(124-122)+$
$(183-124)+(199-183)+(199-41)+(41-14)$

$= 12 + 2 + 31 + 24 + 2 + 59 + 16 + 158 + 27$

$= 331$

10) given.

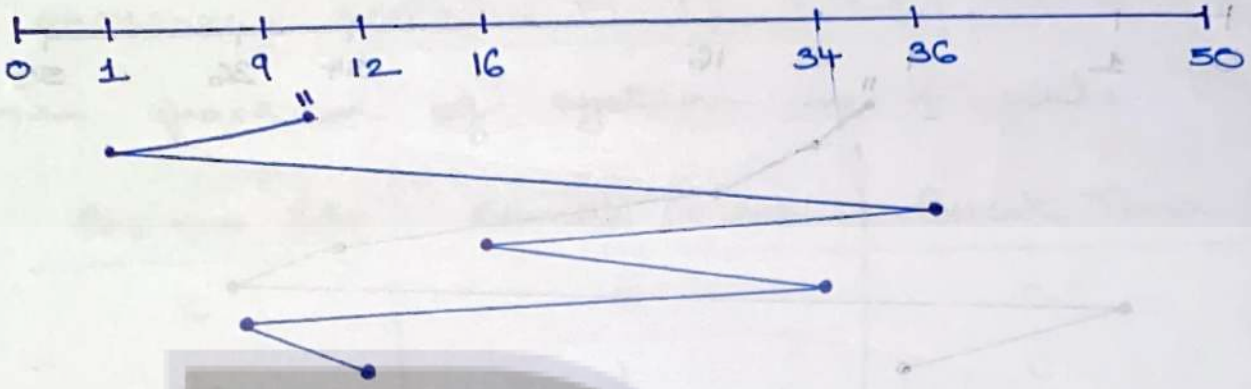
Disk queue ~~for~~ with requests for I/O to blocks on cylinders 1, 36, 16, 34, 9 & 12.

FCFS, SSTF, LOOK, CLOOK, SCAN & CSCAN scheduling algorithm is used.

Head is initially at cylinder no. 11
Cylinders are numbered from 0 to 51.

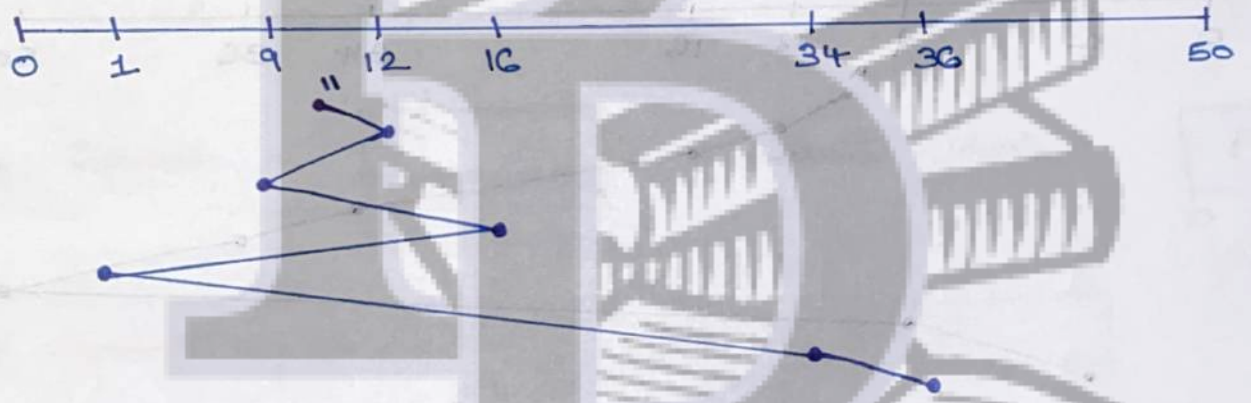
What is the total head movement (in no. of cylinders) incurred while servicing these requests?

FCFS disk scheduling :-



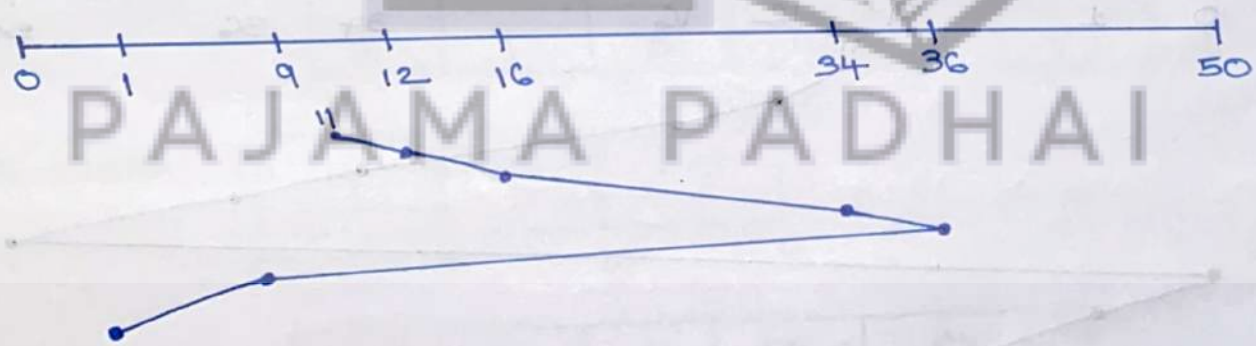
Total cylinder movement = (11-1) + (36-1) + (36-16) + (34-16) + (34-9) + (9-12) = 111

SSTF disk scheduling :-



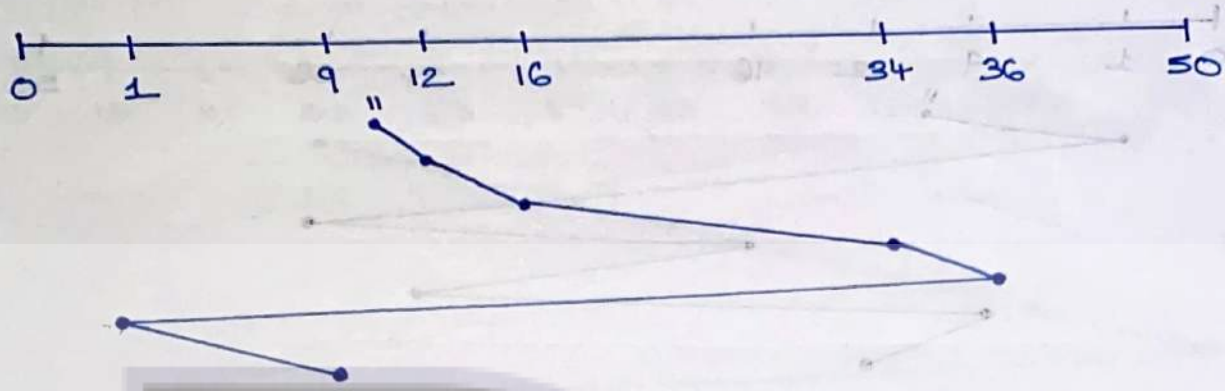
Total cylinder movement = (12-11) + (12-9) + (16-9) + (16-1) + (34-1) + (36-34) = 61

LOOK disk scheduling :-



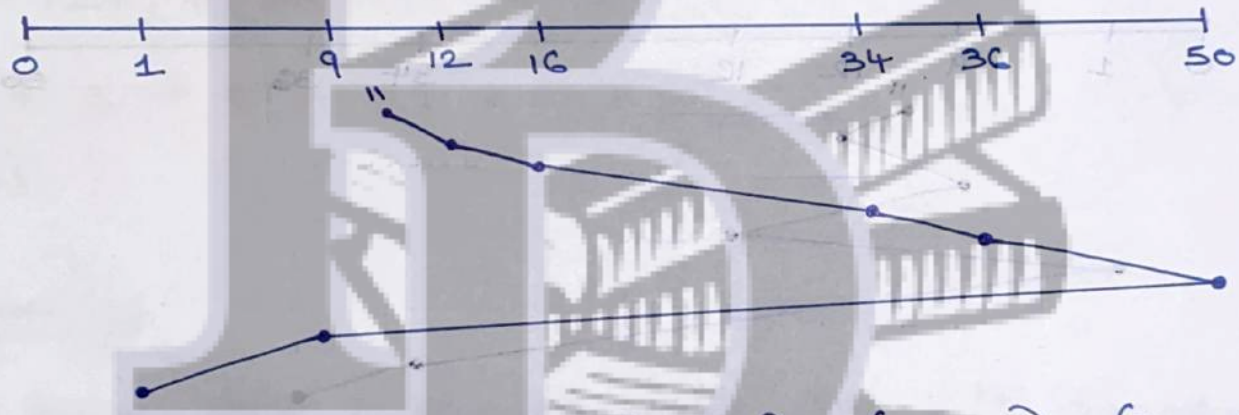
Total cylinder movement = (12-11) + (16-12) + (34-16) + (36-34) + (36-9) + (9-1) = 60

CLOOK disk scheduling :—



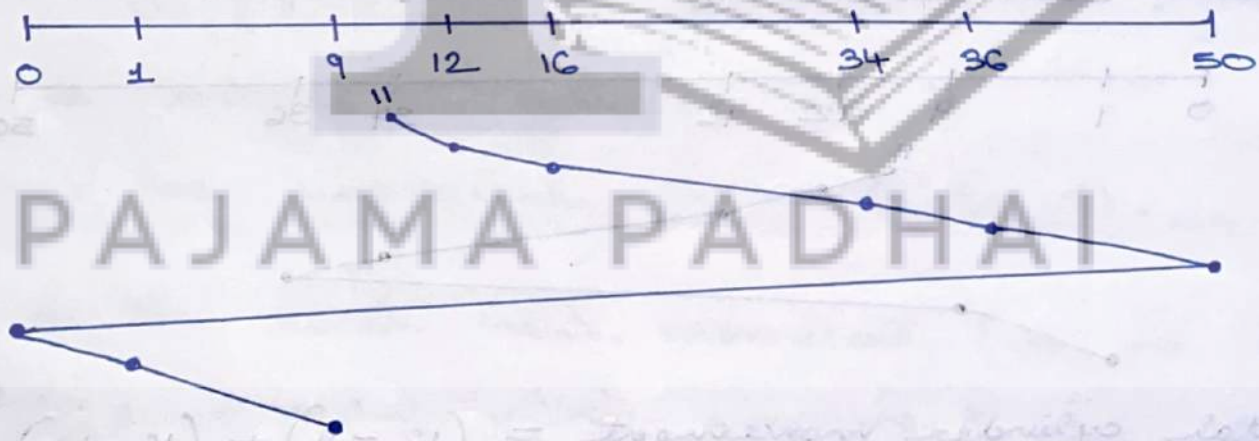
Total cylinder movement = (12 − 11) + (16 − 12) + (34 − 16) + (36 − 34) + (36 − 1) + (9 − 1) = 68

SCAN disk scheduling :—



Total cylinder movement = (12 − 11) + (16 − 12) + (34 − 16) + (36 − 34) + (50 − 36) + (50 − 9) + (9 − 1) = 88

CSCAN disk scheduling :—



Total cylinder movement = (12 − 11) + (16 − 12) + (34 − 16) + (36 − 34) + (50 − 36) + (50 − 0) + (1 − 0) + (9 − 1) = 98